

gave rise to two adult *Opius* on September 16, 1961, or after 322 days from the pupation of the fly. Larvae that pupated on November 15, 1960, produced two *Opius* adults on August 21, 1961, or 279 days after the fly pupated. Since *Opius* oviposition was not observed it is impossible to give accurate figures on duration but the minimum indicated is 279 days, maximum 322 days and an average of 301 days that the wasp spends in the fly pupae.

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### OBSERVATIONS ON THE FLIGHT BEHAVIOR OF AN ASCALAPHID OF THE GENUS ULULODES

(Neuroptera: Ascalaphidae)

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The following notes are offered in the hope that they will be helpful to anyone attempting to work with the genus *Ululodes*. The few observations on behavior reported here, together with an awareness of the physical circumstances necessary to observe this behavior, might suggest the means for more effective sampling of populations and for detailed studies of behavior.

It was noticed that, in areas where these insects abound, they are readily observed or collected during a twenty-minute period commencing about one-half hour after sunset. During this period it is sufficiently dark that the low flying *Ululodes* are not visible

against a background of vegetation or dark soil, but they can be seen in silhouette against a very pale substrate.

In early September of 1951 I first became aware that these neuropterans could be observed easily under such conditions at Molino Basin in the Santa Catalina Mountains near Tucson, Arizona. The site in this case consisted of a clearing, perhaps one hundred by fifty feet, located near the junction of two streams. The area was nearly devoid of vegetation since it was used as a parking lot in connection with a nearby picnic area. The soil was primarily hard-packed, light-colored sand and gravel. The ascalaphids were observed there during many evenings in September of that and more recent years, as well as at two other localities in Arizona where I was able to locate a suitably pale substrate to make observation possible. One of these sites consisted of a whitish sandy portion of a road in Madera Canyon in the Santa Rita Mountains, and the other was the white sand of a broad stream bed in Temporal Canyon near Patagonia.

At the Molino Basin site the ascalaphids were first noticed about twenty minutes after sunset, flying high and coursing particularly around and over the higher oak trees in the area. At this time none was seen to descend lower than about twelve feet above the ground level. Within five minutes occasional individuals were seen at eye level, but, owing to the dark vegetational background bordering the clearing, visibility at this horizon was very poor and probably many more were present than were observed. In another five minutes these insects were visible in some abundance, several being in view at any given moment. During this period their flight horizon appeared to be primarily within a foot or so of the ground, but they would often rapidly ascend to as much as ten feet where coursing was resumed for a few seconds only before they returned to near ground level.

For a fifteen minute period thereafter, that is between about one-half hour and forty-five minutes after sunset, the *Ululodes* were rather common at the site, flying from within a few inches to about three feet above ground level. Their density at the site fluctuated considerably during this period, however, so that they seemed to appear in waves of individuals. At the end of this fifteen minute period there occurred a rather abrupt decline in observed activity. Despite the increasingly poor visibility owing to the gathering darkness, the pale substrate remained an effective back-

ground for observation of these insects, and, occasional individuals were seen during the following five minutes. None were seen after ten minutes prior to the time when darkness had rendered visibility inadequate even over the white substrate.

A gasoline lantern and collecting sheet were operated near the parking lot for many nights during several different years, and no *Ululodes* were collected by this means. On several occasions the lantern and sheet were placed in the clearing while the flight was in progress, and while some of these insects were seen in the vicinity of the light there was nothing about their behavior to suggest that they had responded to the presence of the light. This is of interest since perhaps most of the known specimens of *Ululodes* have been taken at light, but seldom, if ever, in large numbers.

The flight of these neuropterans was quite different from the weak, fluttering flight of myrmeliontids and some other ascalaphids. It was rather rapid, but meandering, not particularly direct, and was frequently interrupted by abrupt changes in course and lateral darting, or rarely, momentary hovering. The flight was quite similar to that of certain Odonata but slower and less direct. During the peak period of the observed flights they appeared to remain within two or three feet of the ground. Those individuals nearest the ground, roughly below the one foot level, seemed to fly slower and to briefly hover more often than did those flying above that level.

Two individuals were observed in coordinated, possibly pre-copulatory, flight. One member was coursing slowly about one foot above the surface and the other member was stationed approximately six inches directly above. This position was accurately maintained for perhaps fifteen or twenty seconds, until an attempt to secure both individuals failed. Another pair was seen, evidently in dorso-ventral contact and probably copulating, as they were flying at a height of two feet quite as rapidly and easily as a single individual. Both were facing forward and one of the members was slightly behind the other. Visibility was not adequate to permit observation of further detail. The pair rapidly separated in the net but the specimens did represent both sexes.

It would seem that, either by utilizing natural clearings with a very pale substrate or, perhaps better, by temporarily applying a portable white overlay to any otherwise suitable area, a great deal could be learned about the habits of these interesting animals.